

Report to the 2005 General Assembly for the period 2002-2005

Activities

Commission C6 had one meeting during the reported period: August 26th, 2004. in Goteborg, Sweden. Most members of the Commission were present. At other occasions contact was kept via e-mail

The meeting was held during the 5th, International Conference on Biological Physics held in Goteborg between August 23-27, 2004. This is the principal conference of the field represented by the Commission.

The Conference had 540 participants, 430 from 43 foreign countries in addition to those from Sweden. This number shows a steady increase during the history of the conference, but it is expected to stabilize around this value. It also shows the true international character of the meeting.

A major point of discussion during the Commission meeting was the evaluation of the status of this conference with respect to other biophysics conferences. It is closely related to the issue concerning the area „biological physics” and its relation to traditional biophysics. Fields are largely determined by the topics, participants of the representative conferences. It is noted that the number of conferences devoted to biophysics is increasing: IUPAB (International Union for Pure and Applied Biophysics) holds conferences every three years (~1000 participants), EBSA (European Biophysical Societies Association) recently decided to hold conferences every second year (~ 700 participants), the annual Congress of the American Biophysical Society (> 1000 participants) is in effect a most significant international general meeting, and the presence of biological physics in the APS Meetings is also constantly increasing. There is inevitably a certain overlap between these events. Thus, it is important to find that reassuringly our meeting has stabilized as a characteristic international meeting of scientists studying the physics of living systems.

It was also concluded that the size of the conference (in the range of about 5-600 participants) can be regarded as optimal. A larger size is at the moment not recommended, since in this case the character of the conference would be less focused and there would be a problem of redundancy with other biophysical conferences.

It was decided that the next International Congress on Biological Physics will be organized in Rio de Janeiro, Brasil in 2007, the organizing headed by C6 Affiliated Member P.M. Bisch from Brasil.

The medical physics community, represented by the International Organisation of Medical Physics (IOMP) and the International Union of Physical and Engineering Sciences in Medicine (IUPESM) expressed interest in establishing close connection with IUPAP to improve the links to academics in contrast to the rather engineering oriented above organizations. Clearly, C6 has natural relation to medical physics, therefore C6 was involved in the discussions with representatives of IUPAP to find an optimal arrangement for the newly established contact. C6 delegated a member as a contact person with related experience to the new Affiliated Commission.

Another new area considered that involved our Commission is the rapidly growing and not clearly defined field of nanoscience. Nanoscience as such is not separately present in IUPAP. In order to clarify the relevance of “nano” in all areas represented by the different Commissions, and to define the relation of IUPAP to nanoscience in general a Nanoscience Working Group was organized with the participation of representatives from various Commissions including C6 (the detailed activity of this working group is reported separately). It was concluded that in physics biological physics has possibly the most obvious “nano” character (since biological macromolecules are of 1 to 100 nanometer characteristic sizes), a move into the nano field can be initiated by organizing a nanobioscience conference with very strong interdisciplinary character and with the active collaboration of various other Commissions, and an initial conference could be held in 2006 Szeged, Hungary. The detailed proposal is in the report of the Nanoscience Working Group.

New developments in the field

The major directions, driving forces in the present development that shape biological physics are the followings: a. New developments in single particle manipulation. B. Vast amount of new data as a result of the genomics approach: c. Improving ability to treat complex systems.

Single particle manipulation

Single particle manipulation remains a favorite and very popular field of development, both the technology and width of applications. With new approaches, continuously increasing sensitivity in practically all areas the principle advantages of single particle observation are more and more exploited. When in an ensemble of a large number of molecules not all molecules explore exactly the same energy landscape, single molecule approach yields information simply impossible to obtain by the traditional techniques. In addition, the single particle observation approach seems to especially excite scientists: presentations of experiments showing biomolecules in action directly are most enjoyable, they attract exceptional attention.

The methods are continuously developing in an evolutionary manner in optical manipulation, scanning microscopy and fluorescence microscopy. It is noteworthy that powerful new optical techniques are developed where resolution far beyond the traditional "diffraction limit" is achieved to yield detailed information at the single molecular level.

The consequences of genomics

It is a characteristic new phenomenon that in the genomics analysis of different species new proteins are identified based on their genes. Numerous proteins were found that would have been not found in the traditional way. The newly discovered proteins in unexpected locations and functions greatly expand the horizons and force us to reconsider major old viewpoints, help make more generalized statements about structure, function of proteins.

Protein structure and function

The structure-function relation of biomolecules remains a fundamental problem of biological physics. In general, understanding the nature and role of dynamics and function of proteins develops at a fast rate. Especially noteworthy is the progress in the area of protein folding. This has developed significantly recently based on the very large number of new structural data. The newly available testing possibilities are a strong driving force for the development of theories, and this is augmented by the corresponding experimental techniques. fast structural relaxations can be followed now with unprecedented resolution. While a complete understanding of the folding problem is still not in reach, major new insight is gained about the basic processes.

The function of proteins is intensively studied by computational methods, molecular dynamics calculations. The development in this area is immense: now very large, complex biological entities can be modeled successfully.

Significant progress is represented by the development in time resolved structural studies: most impressive new data are generated to show important motions of proteins at the atomic level with high time resolution. Such data are crucial for the understanding of the function of proteins.

Complex approach

With the development of experimental methods and theoretical tools, there is a strong tendency to move towards more and more complex systems. It originates in our ability to collect and handle vast number of information about biological objects of all sorts. This process is characteristic of the era of genomics, where the available amount of information about living systems is growing at an unprecedented rate. This approach covers an even broader area: Dynamics of whole cells are now investigated with neutron scattering experiments, previously used to test dynamics of single proteins only. Interactions of proteins, metabolic pathways are studied with special emphasis of numerous interrelations,

networks. Complex functions of the brain are modeled with newly developed theories. It seems that this approach yields a very different picture and totally new and unprecedented results are seen in biology. The new results represent a totally new way of thinking, at all levels. For example, when we consider the function of a single protein, it turns out that it should be regarded as a dynamic entity, member of a possibly most complex network and consequently the particular function that we can observe is likely to be just determined by a set of parameters and different parameters would establish surprisingly different roles. The development in this direction requires a fundamental modification of our picture.

The recent developments also show that the capabilities of physics to treat living systems successfully are improving at a high rate, and we expect the intensity of physical studies directed towards biological objects to continuously grow in all areas.

Pal Ormos, Chair